REMARKS

The application is amended to be in condition for allowance at the time of the next Official Action.

Claims 26-38 and 44-47 are pending in the application. Claims 26-33, 38, 44 and 47 are withdrawn from consideration as being drawn to a non-elected species.

Formal matters

With respect to the denial of entry of the Response filed February 7, 2006, Applicants note that the limitations "excellent flame retardancy" and "nor flame retardant auxiliary" were presented in the amendment of October 26, 2005 and were not added by the response of February 7, 2006.

Nevertheless, claim 34 is amended to remove the term "excellent" to address the concerns of the Examiner.

As to the preclusion of a flame retardant auxiliary, at least page 2, line 1 to page 3, line 4 and page 40, line 22 to page 41, line disclose that the epoxy resin composition of the present invention is free from a flame retardant auxiliary such as diantimony trioxide. In addition, each of the examples in Table 1 to Table 5 uses neither a flame retardant material nor a flame retardant auxiliary.

Accordingly, both the exclusion of a flame retardant auxiliary and what that auxialiary may be are disclosed in the present application.

To address the concern in the Official Action regarding the recited ratio of resin (3) to resin (2), claim 34 is amended to recite a ratio of 1:5.

Based on the above and below remarks, the present amendment is not only believed to place the application in condition for allowance, but is also fully supported by the disclosure.

Arguments on the Merits

The rejection of claims 34-37, 45 and 46 under 35 U.S.C. 103(a) over AKATSUKA et al. JP 9-268219 in view of JP 57-38814 and JP 58-150581, is believed to be untenable at least for the following reasons.

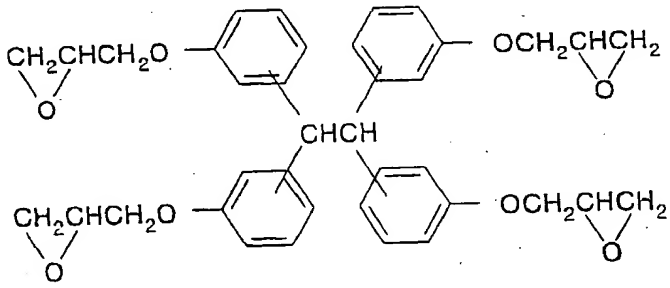
First, the main objective of AKATSUKA of improving water resistance, (i.e. low water absorption) and toughness is not suggested by JP 57-38814 & JP 58-150581 and thus, there would be no motivation to combine the references in the first instance.

Rather, JP 57-38814 & JP 58-150581 teach a process for production of the "tetraphenylolethane epoxy resin" of formula (3) and typical advantage such that "tetraphenylolethane epoxy resin" is suitably employed as a raw material for epoxy resin composition that will gives a cured product having improved thermal properties such as heat distortion temperature and equivalent mechanical properties to that of cured product from epoxy resin composition

containing conventional bifunctional epoxy resin.

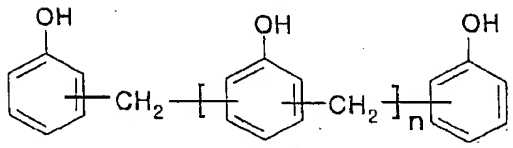
In other words, JP 57-38814 & JP 58-150581 provide only such an evidence that the "tetraphenylolethane epoxy resin" of formula (3) is more suitable for obtaining a cured product having higher heat distortion temperature than conventional bifunctional epoxy resin, such as bisphenol A type epoxy resin (see JP 58-150561), or Epikote 154 (i.e. phenol novolak epoxy resin) as described in JP 57-35814.

In particular, JP 57-38814 shows only an example of epoxy resin composition comprising 1,1,2,2-tetrakis(4-glycidyloxyphenyl)ethane (I):

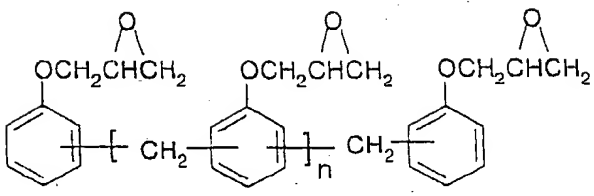


(I)

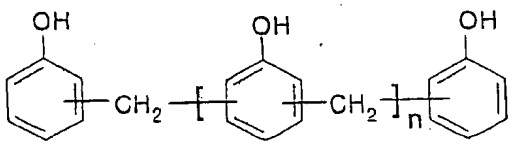
and phenol novolac resin:



, which epoxy resin composition gives a cured product having heat distortion temperature of 203 °C in comparison with epoxy resin composition comprising Epikote 154 (i.e. phenol novolak epoxy resin):



and phenol novolak resin:



which epoxy resin composition gives a cured product having heat distortion temperature of 136 °C. This example indicates just that use of "tetraphenylolethane epoxy resin" is more suitable than use of phenol novolak epoxy resin such as Epikote 154 for obtaining a cured product having higher heat distortion temperature.

However, JP 57-38814 & JP 58-150581 teach nothing about such an advantage that use of "tetraphenylolethane epoxy resin" is more suitable for obtaining a cured product having higher heat distortion temperature than use of the epoxy resin (phenol-biphenyl aralkyl epoxy resin) represented by formula (2) disclosed in ARATSUKA et al. JP 9-268219. Specifically, JP 57-38814 & JP58-150581 fail to provide any evidence that combinational use of "tetraphenylolethane epoxy resin" with the epoxy resin (phenol-biphenyl aralkyl epoxy resin) represented by formula (2) will give a cured product having higher heat distortion temperature than that obtained by using only the epoxy resin (phenol-biphenyl aralkyl epoxy

resin) represented by formula (2).

At least, there is found in JP 57-35814 & JP 58-150581 no reason to conclude that additional use of "tetraphenylolethane epoxy resin" would contribute higher heat distortion temperature than that obtained by using only the epoxy resin (phenolbiphenyl aralkyl epoxy resin) represented by formula (2), when the novolak type resin (novolak type phenolic compound) represented by formula (1) disclosed in AKATSUKA is used as a curing agent.

Accordingly, there would be suggested no motivation for combinational use of "tetraphenylolethane epoxy resin" with the epoxy resin (phenol-biphenyl aralkyl epoxy resin) represented by formula (2) in other to improve the heat distortion temperature obtained by use of only the epoxy resin (phenol-biphenyl aralkyl epoxy resin) represented by formula (2), when the novolak type resin (novolak type phenolic compound) represented by formula (1) is used as a curing agent.

Futhermore, JP 57-38814 & JP 58-150581 teach nothing about any effect in relation with good water resistance (i.e. low water absorption) and toughness ofcured product from epoxy resin composition containing such a "tetraphenylolethane epoxy resin".

Further, JP 57-38814 & JP 58-150581 teach nothing about any effect in relation with flame retardance of cured

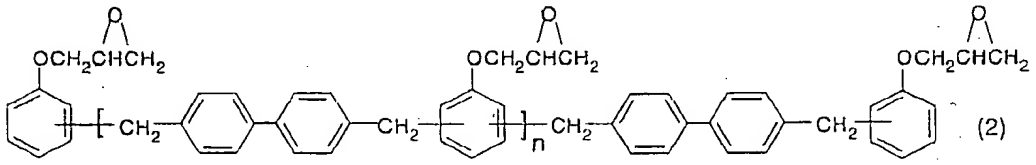
product from epoxy resin composition containing such a "tetraphenylolethane epoxy resin".

Thus, JP 57-38814 & JP 58-150581 fail to establish the combination use of "tetraphenylolethane epoxy resin" with the epoxy resin (phenol-biphenyl aralkyl epoxy resin) represented by formula (2) for the same purpose of obtaining the cured product that is excellent in thermal resistance, a water resisting property, and mechanical strength as that of AKATSUKA.

Second, AKATSUKA teaches away from the proposed combination.

AKATSUKA teaches an epoxy resin composition comprising:

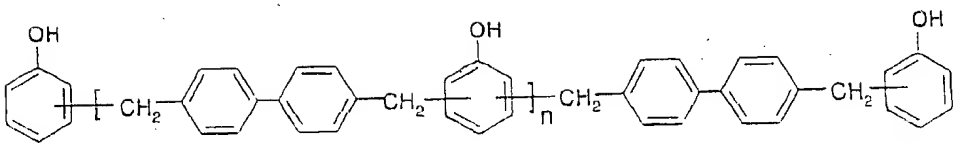
an epoxy resin (phenol-biphenyl aralkyl epoxy resin) represented by formula (2):



(2)

wherein n = 0 to 10, with the proviso that the percentage of the compound of n=0 is 70% or lower in the peak area ratio detected by GPO analysis,

a novolak type phenolic resin represented by formula (1):



(1)

wherein n = 0 to 10, with the proviso that the percentage of the compound of n=o is 70% or lower in the peak area ratio detected by GPO analysis, as an curing agent for said Epoxy resin, and

an inorganic filler in the content of 0 to 90 wt% in the total weight of the epoxy resin composition. Further, AKATSUKA suggests such preferable embodiment where the ratio (OH/Ep) is chosen in the range of 0.7 to 1.2. AKATSUKA teaches just such advantage that the cured product from said epoxy resin composition will have good heat resistance, water resistance, toughness and mechanical strength.

In addition, AKATSUKA gives some suggestion about such general possibility that the phenol-biphenyl aralkyl epoxy resin of formula (2) may be used theref or in combination with another epoxy resin including novolak type epoxy resin, bisphenol-A type epoxy resin, bisphenol-F type epoxy resin and biphenyl type epoxy resin. The specifically exemplified epoxy resins, such as bisphenol-A type epoxy resin, bisphenol-F type epoxy resin and biphenyl type epoxy resin, are essentially of bifunctional epoxy resin type, which has substantially only two epoxy groups in the whole molecule.

AKATSUKA provides no clear definition about whether or not the novolak type epoxy resin in question contains three or more epoxy groups in the molecule. At least, AKATSUKA provides no clear suggestion that other epoxy resins containing more than three epoxy groups than the phenol-biphenyl aralkyl epoxy resin of formula (2) the may be preferably present in an amount of 1/6 by weight per total epoxy resin in order to attain further improved heat resistance for the epoxy resin composition comprising only the novolak type resin (novolak type phenolic compound) of formula (1) as a curing agent.

Rather, AKATSUKA provides only a suggestion that other epoxy resins than the phenol-biphenyl aralkyl epoxy resin of formula (2) the may be present in an amount of 0 to 70% by weight per total epoxy resin for the epoxy resin composition comprising the novolak type resin (novolak type phenolic compound) as a curing agent, in which the novolak type resin (novolak type phenolic compound) is preferably present in an amount of 30 wt% or more per total curing agent.

AKATSUKA provides no evidence proving that even if poly-functional epoxy resin such as the cresol novolak epoxy resin that clearly leads to decreased toughness and increased water absorption when mixed with conventional bifunctional epoxy resin is present in an amount of up to 70% in combination with the phenol-biphenyl aralkyl epoxy resin of

formula (2) a cured product obtained from such a epoxy resin composition will be excellent in a water resisting property and mechanical strength (toughness).

By way of example, a cured product obtained from epoxy resin composition employing only bifunctional epoxy resin such as bisphenol-A type epoxy resin, bisphenol-F type epoxy resin and biphenyl type epoxy resin as epoxy resin component is excellent in a water resisting property and mechanical strength (toughness), even though the cured product obtained does not exhibit high distortion temperature. Therefore, in such a case where the conventional bifunctional epoxy resin is used in combination with the phenol-biphenyl aralkyl epoxy resin of formula (2), a cured product obtained from such an epoxy resin composition will be excellent in a water resisting property and mechanical strength (toughness) and have improved heat resistance.

Similarly, a cured product obtained from epoxy resin composition employing only phenol novolak epoxy resin such as Epikote 154 that is mixture of bifunctional epoxy resin (major component) and trifunctional epoxy resin (minor component), as epoxy resin component may be good in a water resisting property and mechanical strength (toughness), even though the cured product obtained does not exhibit high distortion temperature.

Therefore, in such a case where the conventional

phenol novolak epoxy resin is used in combination with the phenol-biphenyl aralkyl epoxy resin of formula (2), a cured product obtained from such an epoxy resin composition will be excellent in a water resisting property and mechanical strength (toughness) and have improved heat resistance.

Based on this, the novolak type epoxy resin in question suggested in JP 57-38814 may be considered to be such a phenol novolak epoxy resin that is mixture of bifunctional epoxy resin (major component) and trifunctional epoxy resin (minor component).

However, as disclosed in AKATSUKA, the use of the phenol-biphenyl aralkyl epoxy resin of formula (2) by itself provides sufficiently excellent heat resistance, and thus there is no motivation to further improve heat resistance by using "tetraphenylolethane epoxy resin" in combination with the phenol-biphenyl aralkyl epoxy resin of formula (2).

Moreover, AKATSUKA teaches nothing about whether or not the cured product from the aforementioned epoxy resin composition would exhibit flame retardance without the help of a flame retardant material or a flame retardant auxiliary.

As for the objectives of AKATSUKA, the main objective is clearly directed to an epoxy resin composition, which gives a cured product that is excellent in water resisting properties and mechanical strength (toughness).

Additionally, paragraph [0003] of AKATSUKA contains

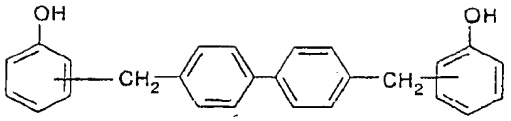
the description "although thermal resistance becomes high in the cured product obtained when polyfunctional epoxy resins, such as a cresol novolak epoxy resin, are mixed, said cured product has a fault that toughness falls down and water absorption rise up". This description appears to indicate that use of polyfunctional epoxy resin other than the phenol-biphenyl aralkyl epoxy resin of formula (2) may be unfit for the main aim of AKATSUKA to improve water resistance and toughness.

At least, there is no suggestion that combinational use of polyfunctional epoxy resin having three or more epoxy groups in the whole molecule such as "tetraphenylolethane epoxy resin" of JP 57-38814 or JP 58-150581 would be fit to retain the improved water resistance and toughness resulted from the use of the phenol-biphenyl aralkyl epoxy resin of formula (2).

Third, AKATSUKA also teaches away from using a tetraphenylolethane epoxy resin.

The novolak type resin (A) of Example 1 disclosed in AKATSUKA appears to be a mixture of bifunctional phenolic resin and trifunctional phenolic resin, as explained below.

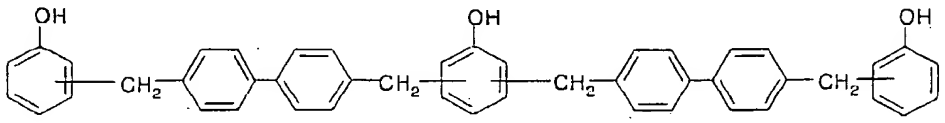
The novolak type resin (A) of Example 1 contains 23% of the compound with n=0 as presented by following formula (5-0):



(5-0).

The molecular weight of the compound of formula (5-0) is about 366, and the corresponding hydroxyl equivalent being 183 g/eq.

The compound with n=1 as presented by following formula (5-1):



(5-1)

has a theoretical molecular weight of 646, and the corresponding epoxy equivalent being about 215 g/eq.

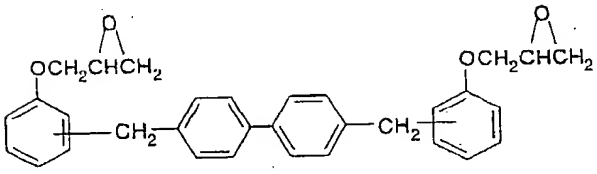
The observed hydroxyl equivalent of 203 g/eq. for the novolak type resin (A) is equivalent to average for a mixture of 23% of the compound of formula (5-0) and 77% of the compound of formula (5-1), and thus the novolak type resin (A) appears to be a mixture of 23% of the compound of formula (5-0) and 77% of the compound of formula (5-1).

The epoxy resin (B) of Example 2 disclosed in AKATSUKA is prepared by using the novolak type resin (A) as starting material.

Therefore, the epoxy resin (B) of Example 2 disclosed in AKATSUKA appears to be a mixture of bifunctional

epoxy resins and trifunctional epoxy resin, as explained below.

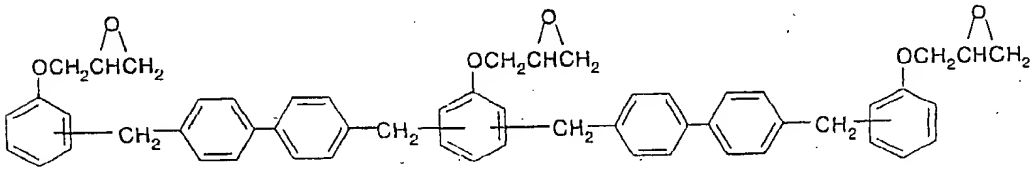
The epoxy resin (B) of Example 2 contains 19% of the compound with n=0 as presented by following formula (6-0-2):



(6-0-2).

The molecular weight of the compound of formula (6-0-2) is about 478, and the corresponding epoxy equivalent being 239 g/eq.

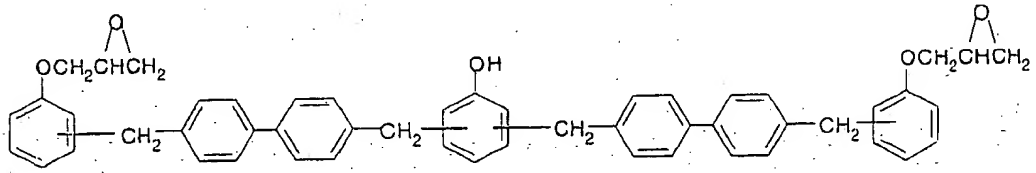
The compound with n=1 as presented by following formula (6-1-3):

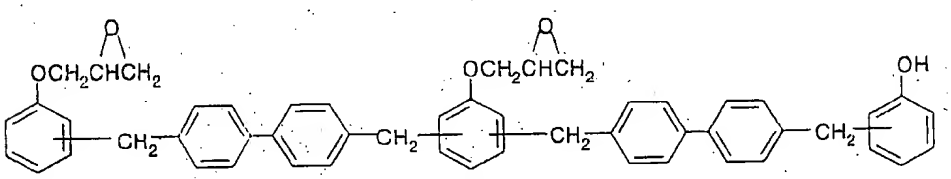


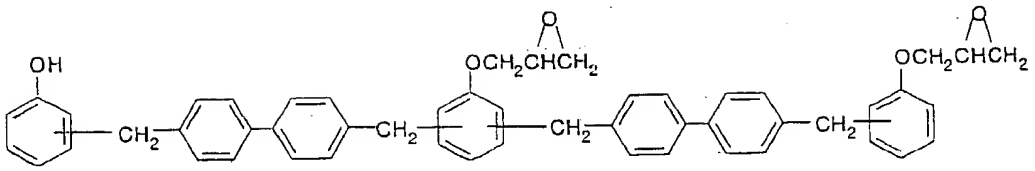
(6-1-3)

has a theoretical molecular weight of 807, and the corresponding epoxy equivalent being 269 g/eq.

The compound with n=1 as presented by following formula (6-1-2):







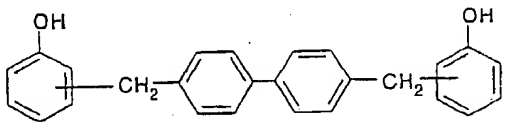
(6-1-2)

has a theoretical molecular weight of 740, and the corresponding epoxy equivalent being 370 g/eq.

The observed epoxy equivalent of 277 g/eq. for the epoxy resin (B) is equivalent to average for a mixture of 19% of the bifunctional compound of formula (6-0-2), 14% of the bifunctional compound of formula (6-1-2), and 67% of the trifunctional compound of formula (6-1-3), and thus the epoxy resin (B) appears to be a mixture of 19% of the bifunctional compound of formula (6-0-2), 14% of the bifunctional compound of formula (6-1-2), and 67% of the trifunctional compound of formula (6-1-3).

Similarly, the novolak type resin (C) of Example 3 disclosed in AKATSUKA appears to be a mixture of bifunctional phenolic resin and trifunctional phenolic resin, as explained below.

The novolak type resin (C) of Example 3 contains 41% of the compound with n=0 as presented by following formula (5-0):

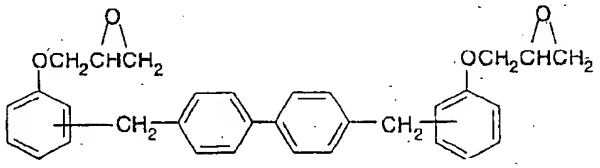


(5-0).

The observed hydroxyl equivalent of 198 g/eq. for the novolak type resin (C) is equivalent to average for a mixture of 41% of the compound of formula (5-0) and 59% of the compound of formula (5-1), and thus the novolak type resin (C) appears to be a mixture of 41% of the bifunctional compound of formula (5-0) and 59% of the trifunctional compound of formula (5-1).

The epoxy resin (D) of Example 4 disclosed in AKATSUKA is prepared by using the novolak type resin (C) as starting material. Therefore, the epoxy resin (D) of Example 4 disclosed in AKATSUKA appears to be a mixture of bifunctional epoxy resins and polyfunctional epoxy resin, as explained below.

The epoxy resin (D) of Example 2 contains 35% of the compound with n=0 as presented by following formula (6-0-2):



(6-0-2).

The observed epoxy equivalent of 271 g/eq. for the epoxy resin (D) is equivalent to average for a mixture of 35% of the bifunctional compound of formula (6-0-2). 13% of the bifunctional compound of formula (6-1-2), and 52% of the trifunctional compound of formula (6-1-3), and thus the epoxy

resin (B) appears to be a mixture of 35% of the bifunctioflal compound of formula (6-0-2), 13% of the bifunctional compound of formula (6-1-2), and 52% of the trifunctional compound of formula (6-1-3).

Taking these typical examples in consideration, AKATSUKA seems to suggest only that use of a mixture of bifuctional epoxy resin and trifunctional epoxy resin may be suitable for the main aim of AKATSUKA to improve water resistance and toughness.

However, AKATSUKA gives no suggestion that use of a mixture of bifuctional epoxy resin and trifuctional epoxy resin in combination with considerable amount of tetrafunctional epoxy resin such as "tetraphenylolethane epoxy resin" would be also useful to improve water resistance and toughness. There is no reasonable basis to expect that the cured product obtained with use of "tetraphenylolethane epoxy resin" of formula (3) would show as good water resistance and toughness as the cured product obtained with use of phenol-biphenyl aralkyl epoxy resin of formula (2).

Rather, the description of paragraph [0003] of AKATSUKA teaches away from such combination by suggesting that water absorption would rise up and toughness would fall down in case of using the "tetraphenylolethane epoxy resin" of JP 57-38814 or JP 58-150581 as well as the use of polyfunctional epoxy resins such as a cresol novolak epoxy

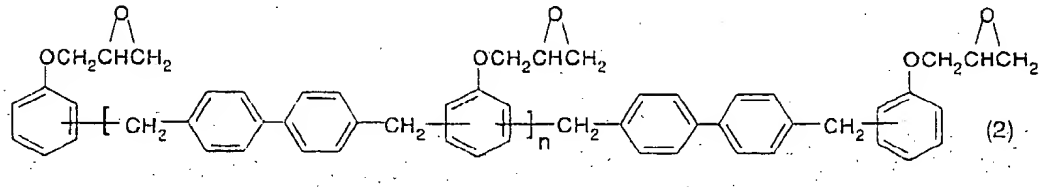
resin.

In this view, a person skilled in the art may think at least that such combinational use of "tetraphenylolethane epoxy resin" of JP 57-38814 or JP 58-150581 with the phenol-biphenyl aralkyl epoxy resin of formula (2) is not consistent with the purpose of AKATSUKA for obtaining a cured product being superior in water resistance and toughness.

At least, JP 57-38814 & JP 58-150581 fail to provide any reasonable suggestion that use of "tetraphenylolethane epoxy resin" of formula (I) will give a cured product being excellent in water resistance and toughness. Thus, there is no reasonable predication that the inclusion of "tetraphenylolethatle epoxy resin" in place of "cresol novolak epoxy resin" would be consistent with the objectives of Ref. 10: 3? 9-268219 to provide excellent water resistance and toughness for a cured product thereof.

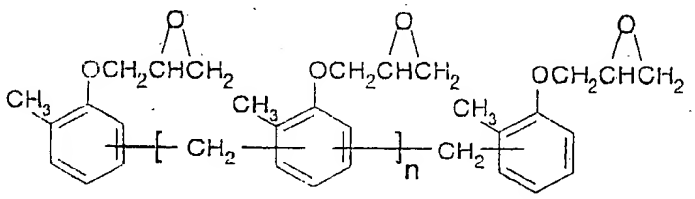
Accordingly, there is no motivation for combining polyfunctional epoxy resins such as the "tetraphenylolethane epoxy resin" of formula (I) with the epoxy resin (phenol-biphenyl aralkyl epoxy resin) represented by formula (2), wherein the ratio of the tetraphenylolethane epoxy resin to phenolbiphenylaralkyl epoxy resin epoxy resin of formula (2) is 1/5 in order to provide excellent water resistance and toughness for a cured product thereof as required by AKATSUKA.

In addition, the epoxy resin (phenol-biphenyl aralkyl epoxy resin) represented by formula (2):



(2)

wherein n = 0 to 10, as well as the "cresol novolak epoxy resin":



are included in group of polyfunctional epoxy resins. AKATSUKA teaches that the use of epoxy resin (phenol-biphenyl aralkyl epoxy resin) represented by formula (2) may provide enough improvement with respect to the heat distortion temperature by itself. In such a case, there would be no need to further use the "tetraphenylolethane epoxy resin" of formula (I) in combination with the epoxy resin (phenolbiphenyl aralkyl epoxy resin) represented by formula (2) in order to obtain a cured product with high heat distortion temperature.

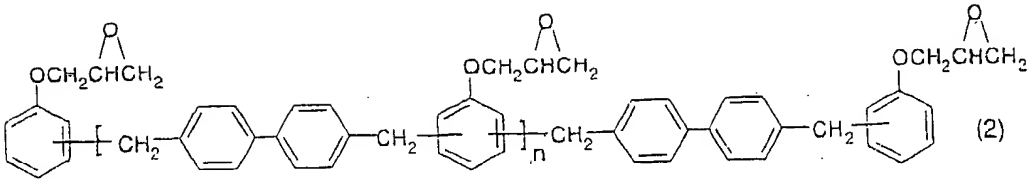
Fourth, even if there were motivation to combine the references in the manner suggested, there is no evidence indicating that a cured product having good heat resistance,

water resistance and toughness will always exhibit good flame retardance without any help of flame retardant material or flame retardant auxiliary.

Indeed, Shimizu et al. 5,854,316, which was cited in the Office Action dated January 22, 2003, teaches a cured product from Comparative Example (6) listed in TABLE 2 having good heat resistance, water resistance and toughness, but the cured product from Comparative Example (6) exhibits poor flame retardance of V-2 grade.

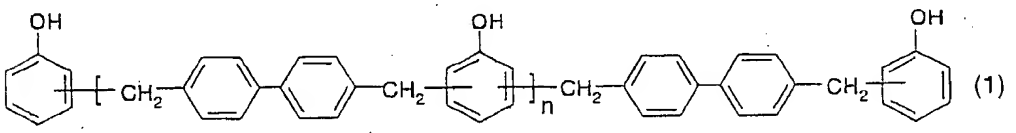
In addition, Osada et al. USP 6,160,078, which was cited in the Office Action dated September 14, 2004, teaches a cured product from epoxy resin composition of Example 1 has good heat resistance, and the cured product also exhibits good flame retardance of V-0 grade. A cured product from epoxy resin composition of Comparative Example 2 has good heat resistance, but the cured product exhibits poor flame retardance "burned".

As for a cured product having improved flame retardance without any help of flame retardant material or flame retardant auxiliary, AKATSUKA fails to provide any evidence suggesting that the cured product from an epoxy resin composition comprising an epoxy resin (phenol-biphenyl aralkyl epoxy resin) represented by formula (2):



wherein n = 0 to 10,

a novolak type phenolic resin represented by formula (1):



wherein n = 0 to 10, as a curing agent for said Epoxy resin, and 70-90 wt% of silica particle as an inorganic filler will be excellent in flame retardance without flame retardant material or flame retardant auxiliary, by virtue of the particular blend ratio of phenol–biphenyl aralkyl epoxy resin of formula (2), novolak type phenolic resin of formula (1) and silica particle.

In view of the above, it has been shown that AKATSUKA in view of JP 57-38814 and JP 58-150581 fails to provide a reasonable suggestion that an epoxy resin composition as claimed in Claim 34 will give a cured product having good flame retardance without flame retardant material or flame retardant auxiliary.

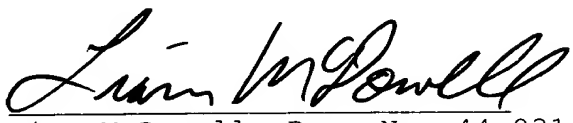
In view of the present amendment and the foregoing remarks, it is believed that the present application has been placed in condition for allowance. Reconsideration and

allowance are respectfully requested.

The Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 25-0120 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17.

Respectfully submitted,

YOUNG & THOMPSON



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